

INL Activities to Support the Application of Seismic Isolation Technologies to Nuclear Power Plants

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Seismic Isolation (SI) has been shown to protect buildings and bridges from the effects of intense earthquake ground motions. Because SI is being considered for nuclear power plants (NPPs) in the US, the Nuclear Regulatory Commission (NRC) initiated research activities in 2009 to develop new guidance targeted at isolated facilities. That work, which was focused around a risk-informed regulatory approach, resulted in a draft NUREG report (Kammerer et al., forthcoming) and two MCEER reports (Kumar et al. 2015a, 2015b) that investigated and discussed considerations for the implementation of SI technology in NPPs. The draft SI NUREG report provided a set of recommended performance objectives and criteria that could serve as the foundation for future guidance on the use of SI and related technology. Methods of analysis and design for NPPs using SI, have also been proposed and implemented in the soon-to-be-published American Society of Civil Engineers Standard ASCE/SEI 4-16 (ASCE, 2016).

While these foundational documents provide a good starting point, they were, necessarily limited in scope. The clear focus of the guidance is the horizontal base isolation of surface-founded light water reactors (LWRs). To identify and address the limitations in the existing guidance, Idaho National Laboratory (INL) has initiated several projects focused on further developing the technical and licensing underpinnings for facilities using SI technology. This work at INL started with a 2014 workshop summarized in INL Report INL/EXT-14-33234 (Coleman and Sabharwall, 2014).

The Advanced Nuclear Technology group at INL recently sponsored work to identify regulatory gaps and challenges related to the use of SI technology in advanced reactors. This work resulted in INL report INL/EXT-15-36945 (Kammerer et al., 2016), which furthered the guidance available to industry and the NRC. Some of the tools, techniques, and hardware developed for the seismic isolation of the LWR of will be applicable—in principal—to advanced reactors, including deeply embedded facilities. However, new methods of seismic analysis, design, construction, and risk assessment will be required for advanced reactors. These new methods bring with them additional regulatory gaps and challenges. Moving forward, INL is undertaking work to develop a plan to address the gaps and challenges identified in Kammerer et al. (2016) and to further develop the technical bases related to the use of SI technologies in US NPPs.

Coupled with this effort, INL and MCEER at the University at Buffalo initiated work with TerraPower, LLC through a Cooperative Research and Development Agreement (CRADA) to develop a methodology for evaluating the potential benefits of SI and to support advancements in the associated numerical modeling tools and approaches. A focus of the CRADA is to couple a validated non-linear soil-structure interaction methodology with advanced numerical models of isolator units to enable the risk-based design and safety-related nuclear facilities.

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